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œsophageal ganglia. It follows necessarily that the tube around which the nervous matter has been formed, *i. e.*, the central canal and ventricles, represents part or the whole of the alimentary canal of the vertebrate ancestor. The author believes that he has found in the infundibular region the remains of the terminal œsophageal tube. In the light of this view we have sufficient reason for the degeneration of certain components of the foremost group of nerves, for with the loss of function of the invertebrate alimentary canal, and mouth parts in connection with it, the sensory parts of the nerves supplying that region degenerated.—*Leah Goff.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHRCPOMETRY AS APPLIED TO THE DETERMINATION OF THE ATTRIBUTES OR POWERS OF THE MIND OF MAN.—This is a problem. My only purpose is to consider its feasibility. Its benefits will be apparent. Can it be done?

It will not do, in this age of science, to determine on the entrance to the consideration of a given subject that its discovery or elucidation is impossible because of its extent, distance, mystery, or difficulty. These may be a bar to its discovery, but not to its consideration or attempted discovery.

The scientific discoveries made within the last few years are sufficient answer to this. What question presents greater apparent difficulties—impossibilities that the knowledge that the composition of the flame of the sun or the fixed stars—yet the solar and stellar spectrum has resolved these into their original elements, and we know them as well as we do that of the candle or the coal, which burn before our eyes.

Professor Langley has just informed us that the greater part of the sun's rays are not luminous, and that those which are, are really blue, and not white.

Who could have foreseen that when Galvani, of Bologna, in dissecting a frog (what nonsense, for a great philosopher to fool away his time dissecting frogs!), should have touched with a wire a given nerve, and that the twitch it made in response to his touch should have since then run through a million miles of wire, over the land like the network of the fowler, and through the sea like the seine of the fisherman, until with its sudden cession, the trade, commerce, and government of the world would come to a standstill?

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[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

Professor Bell, one of our countrymen, has taken one of these wires—it may be a thousand miles long—and put on it at one end a patent mouth and at the other a patent ear, which can speak and hear with as much distinctness as if they were both attached to the same head.

The latest invention is a machine, about the size of a small sewing machine, into which one may speak in his natural voice, then boxing up his speech, may, after a thousand years of time, or at a thousand miles distance, by the simple turning of a crank, unwind the same speech in the same tone and voice as it was spoken.

Surely, there is much new under the sun.

After this preamble upon the possibilities of science, let us see if we may not measure and record in figures the attributes of man's mind.

Man holds communication with the outside world through his five senses. The action of either of those produce a sensation. Sensation produces perception, and perception intelligence. If we can measure the sensation we are on the road to measuring the perception, and so on, to the understanding and intelligence, and possibly the mind in its more subtle and abstruse operations.

What a conquest of science if we could be able to measure the sensations produced upon the mind, and passing through the upward scale, to calculate the mental force expended, say by Webster in his great constitutional arguments, or by determining the vividness and depth of perception, and so of understanding; to be able to calculate, by mathematical formulas, the reserve mental power necessary to make such arguments.

Decision requires an entire mental operation. It pre-supposes choice; choice, discrimination; discrimination, impression or sensibility; and this, sensation, which is obtained through one of the organs of sense. The operation of this organ, say of sight, can be easily measured, and one step accomplished. Is it not possible to continue it further?

The higher and more complex operations of the human mind may not now be measured. But why not the lower and simpler? When thus measured in different individuals may not their differences denote their differences in mental calibre?

One child knows a letter or figure, remembers it, understands it, on seeing it once; another requires twenty times; while the learned pig can only spell or count on being shown the same letter or figure, a hundred, maybe a thousand times.

Animals can be taught many mental operations. I recall the performing elephants, dogs, bears, monkeys, birds, even the fly and the flea, while Sir John Lubbock has ascertained the sensibility of the ant in the matter of sight, hearing, smell, and has shown that he can receive impressions through these senses which lead up to perception, understanding and decision. Sir John discovers that the ant has a goverment, and consequently a governor. He will emigrate to any other country, can organize an army; make raids, fight battles, take prisoners whom he enslaves. It is highly interesting to count the needed sensations, impressions, and perceptions required to perform all these mental operations.

The same system by which this can be measured or counted in our experiment with the animal can be applied to man.

What are school examinations or college commencements but tests by measurement or counting of the mental capabilities of the students? They may be only for comparison one with another; but that comparison is made by measurement more or less indefinite. At West Point and Annapolis the comparison is made with an absolute standard, in which 1000 is perfection. The system may be anomalous, for unblacked shoes and unkempt hair may so reduce it as to defeat his promotion.

Color blindness and astigmatism are measured by the oculist. They may be diseases or caused by defective mechanism, but these are only determined by measuring the sensations produced in the mind.

The measurement of a mental sensation is something accomplished, and I would pursue the same line of investigation to its end. Examine the candidate for the *truthfulness*, the *fidelity* of his sensation. First as to his sense of color. The question is, what sensation is produced upon his mind by the sight of a strand of worsted of a given color? Does green give the proper sensation, or purple, or red? This is a test of the *correctness* of the impression as to color. The operation is done leisurely. Rapidity is not now required. It is *accuracy* which is now being tested. As his examination progresses mark on the chart his successes or his failures. The fault in his sense of color may result from a species of disease. But now we test his sensation as to size, form, etc., which is not affected by disease, but it is a question purely of truthfulness of sensation or impression. Show him a yard stick, and let him mark the middle of it—divide it into feet or inches. Let him do it slowly but correctly. Compare two lengths—draw parallel lines, some true and some untrue—try him with angles, right, and other than right. Invent methods to test the correctness of his impression on his mind as derived from the operation on the sense of sight.

As a second lesson or course give him the chalk and let him make on the board the lines which he has just tried. Let him make a straight line of certain length; an inch, a foot, a yard—a right angle, a square, a circle, parallel lines, etc., etc.

Having exhausted correctness, test him for rapidity—have him do the same things and in addition to correctness, require rapidity.

To correctness and rapidity in such elementary matters let us add the test of power of observation, that is, the capacity to *see* things, to see them correctly, rapidly, and to note their number, position, quality, etc. This is only to note the sensation obtained from a larger view than the sticks and lines first shown. It is still the mental impression derived from the operation of the sense of sight.

March the candidates or class into a room, stay five minutes, and out again—then describe every article seen; try one minute; try unfamiliar rooms; try a picture; conduct them past an open door at a slow pace, and then ask them to tell every article seen in the room.

All these tests can be registered for each candidate, and the result will be his mental capacity in each of these regards, correctly expressed in figures.

Then try him with the sense of hearing, of touch, possibly of smell. You will say this will sharpen his senses. I prefer to say it will sharpen his *wits*—that it educates him, it causes him to correctly note the impression of the object as presented to the senses and as correctly to report or carry it to his mind. All this is but that mental quality called attention. After attention, memory. Thus we may measure by Anthropometry the mental qualities of sensation, impression, attention, and memory.

These are the faculties by which the mind of man receives its communications from the world. By their means it obtains the raw material to be worked up in the laboratory of thought.

MEASUREMENT OF MAN'S REASON.

How many are twice two? Twice ten? Easy enough to tell. How many are twice 17.648? Seven times that? Twelve times that? The mental operations required are those we have just been measuring, and we who have perceived in them the highest grade will succeed here the best. First attention to impression and sensation, then correctness, and finally, rapidity. All these tests to be recorded. Thus we may progress through mathematics, logic, philosophy, and so on to the end, practicing continually our first and fundamental rules of Attention, and Correctness of Impression, or Sensation.

The thoughtful man can follow this system out in detail, can perceive how it can be accomplished. I can see how, by the introduction of some such system, not only the average mental capacity or power of a nation or a people might be measured, the result announced in figures, and a comparison made with other nations; also that its use might tend to increase that capacity and power.

Such are the higher uses of Anthropometry. The human mental capacity *to understand* things is nearly allied to its capacity to *see* things. If one can be done I should not despair of the other. Whatever can be done with either must be by experiment directed by observation, Experiments must be repeated and the observations recorded. This means counting and measuring; and this applied to man is the Science of Anthropometry.

These are some of the possibilities of Anthropometry, but they are as yet far beyond the scientists of the United States.

We must content ourselves for the present with obtaining full, complete, and reliable tables of measurements of the physical peculiarities of the various races which inhabit our country. This should be our immediate contribution to the world's science.

MICROSCOPY.[1]

THE RETINA OF THE BIRD. — Cajal[2] recommends the method of Golgi for the study of the retina. He proceeds as follows:

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[1] Edited by C. O. Whitman, Clark University, Worcester.

[2] Anat. Anz., iv., No. 4, Feb., 1889, p. 112.